Spurious Structure in Representational Similarity Analysis and a Bayesian Approach to Reducing Bias in Rsa of fMRI Data

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Presentation Abstract Summary Representational similarity analysis (RSA) calculates the similarity between spatial activity patterns of a brain region in different cognitive states or in response to different stimuli or task conditions. It allows for comparing computational models of cognition against neural data at the level of representational structure. Recently, it was found that RSA results of fMRI data strongly depend on the temporal distance between events of an experiment. Here we analytically derive the source of the confound and provide a solution. We show that autocorrelated fMRI noise and temporal relationships between task events together introduce structured noise into the estimated neural patterns. Correlation analysis of the estimated patterns translates this structured noise into spurious bias structure in the similarity matrix. We propose an alternative framework of RSA, an extension of the Pattern Component Model. Our method relies on a generative model of fMRI data in which the covariance structure of neural activity patterns is treated as a hyper-parameter of the patterns. By marginalizing the unknown activity patterns, the method directly estimates the covariance structure (thus the similarity structure) from imaging data and significantly reduces bias.

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